PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F25D 25/04, 3/11

A1

(11) International Publication Number: **WO 96/00371**

(43) International Publication Date: 4 January 1996 (04.01.96)

(21) International Application Number: PCT/EP95/02426

(22) International Filing Date: 23 June 1995 (23.06.95)

(30) Priority Data:
0757/94 24 June 1994 (24.06.94) DK

(71) Applicant *(for all designated States except US)*: L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE [FR/FR]; 75, Quai d'Orsay, F-75321 Paris Cédex 07 (FR).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: WERNER NIELSEN, Mogens [DK/DK]; Ærøvej 15, DK-8700 Horsens (DK).

(74) Common Representative: L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE; 75, quai d'Orsay, F-75321 Paris Cédex 07 (FR).

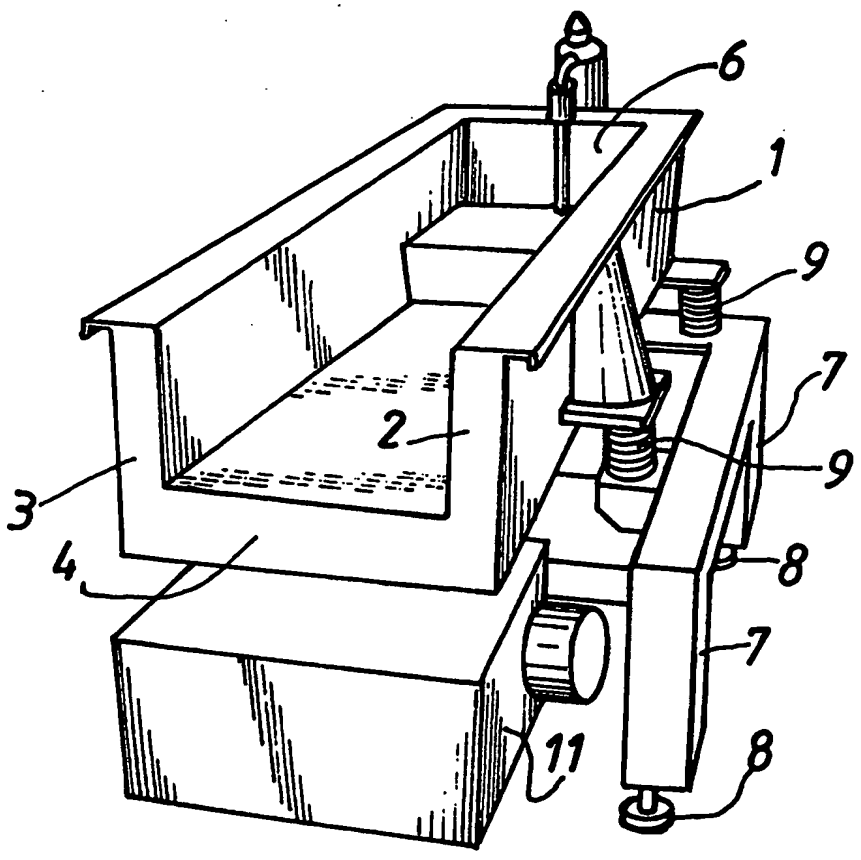
(81) Designated States: CA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: A FREEZING APPARATUS AND USE OF IT

(57) Abstract

A vibration freezing apparatus in particular for loose state freezing of granulated products, such as shrimps, minced meat and the like. The freezer has a vessel (1) with a bottom (4), two side walls (2, 3) and an end wall (6). An elevation (22) is provided at the open end of the vessel (1), thereby forming a reservoir for liquefied nitrogen. The height of the liquefied nitrogen is partly determined by the steepness of the ramp and the signal from an ultrasound sensor arranged close to the end wall (6) of the vessel. The sensor and the separator may be removed from the end wall of the vessel, which may be placed in an inclined position by means of at least one air cylinder in which it is easy to clean. The apparatus is unique in having a simple structure and being easy to clean, which is of great importance for maintenance of good hygiene.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

A freezing apparatus and use of it

The invention concerns a freezing apparatus of the type where a product is supplied to an open vessel in which liquefied nitrogen is conveyed together with the product and flows from one end of the vessel to the other, open end of the vessel, and where a vibrator means may vibrate the vessel for conveying the product. Further, the invention concerns a use of the freezing apparatus.

Nitrogen freezing devices are used for freezing articles such as hamburgers, shrimps, clams, fish fillets, ready-made dishes, processed meat, etc.

Liquefied nitrogen is a colourless liquid of low viscosity which has a temperature of about -196°C and is extremely useful for the freezing of articles. Liquefied nitrogen provides very rapid freezing which is particularly useful for the freezing of articles which are present on a product line. Further, the rapid and carefully controlled freezing ensures that the original quality of the article is maintained to the best possible extent at a uniform and high level. In other words, the article, after having been frozen, does not, or only to a limited degree, change its appearance, its taste or its consistency.

Nitrogen freezers may be built in many different ways.

The most common ones are :

1. Tunnel freezers,
2. Spiral freezers,
3. Immersion freezers,
4. Freezing cabinets, and
5. Vibration freezers.

It is common to the two first types that the article is conveyed on a conveyor belt and is sprayed with atomized, liquefied nitrogen. The spiral freezers may be constructed for greater capacities than the tunnel freezers.

Also the third type employs a conveyor belt, but the article is here immersed in a bath of nitrogen on the conveyor belt. The article which is immersed in the nitrogen bath is cooled very rapidly, which means that this type of apparatus has an extremely great capacity.

Where batch articles are to be frozen, freezing cabinets are typically used. Freezing takes place by circulation of very cold nitrogen gas past the articles which are placed on shelves in the freezing cabinet.

As appears from the above, products to be frozen in the above-mentioned devices are to be placed on a conveyor belt or on shelves. In other words, the non-frozen article will have direct contact with a substrate prior to freezing. This is not always expedient, in particular not in case of so-called granulated products, such as minced meat with fat and water which, when being frozen on a conveyor belt, may freeze onto the conveyor belt and moreover freeze together as one big lump.

The fifth type of nitrogen freezer, which is a vibration freezer and of the type with which the invention is concerned, is used for avoiding the above-mentioned problem.

In vibration freezers the article is caused to contact liquefied nitrogen directly under vibration of the article and the nitrogen.

Thus, a known vibration freezer in principle consists of a vessel where liquefied nitrogen is supplied at one end together with an article, such as minced meat, shrimps and other similar products, where complete or partial freezing is desired, ensuring that the articles do not stick together.

If it is imagined e.g. that a meat product, such as minced meat having a certain water content, is to be frozen, it will be appreciated that it will be extremely difficult to place such a product on a conveyor belt, since it will quite simply stick to the conveyor belt.

Therefore, the above-mentioned products are usually frozen in a vibration freezer, which, as mentioned, has a vessel which is open at one end. Liquefied nitrogen and the article are supplied at the closed end of the vessel, there being thus provided a bath of the nitrogen in the vessel. A grid is provided at the other, open end of the vessel where the excess nitrogen may be discharged to a container, from which it is recirculated to the closed end of the vessel by a pump. This has the advantage that the amount of consumed liquefied nitrogen is kept at a reasonably low level, which is not entirely without importance since liquefied nitrogen is relatively expensive.

As mentioned, such a known vibration freezer having a grid is extremely useful for many types of freezing tasks where freezing of articles in a loose state is desired.

However, owing to very strict hygiene requirements, the use of the grid and the subsequent recirculation system in which the liquefied nitrogen is recirculated, involves a small problem. The reason is that although the articles supplied to the nitrogen are frozen, part of the article will inevitably run down into the grid and be recirculated. Thus, as product residues may occur in the recirculation system, it is necessary to have a very high cleaning hygiene comprising cleaning of the entire recirculation system. Since, however, water is used in connection with the cleaning, it will be appreciated that operational stoppages can easily occur if wiping is not performed with great care, since the liquefied nitrogen will then convert the present moisture into ice, which involves the risk of operational stoppages.

The applicant has also noted that it was important that the articles to be frozen remain constantly in contact partly with the liquefied nitrogen and partly with the bottom of the vessel.

Indeed, contact with the bottom of the vessel is necessary to impart forward motion to the articles via

the vibration means of the freezing apparatus. Depending on the size, specific gravity and desired residence time of the articles, it is therefore necessary to maintain a constant and precise liquid nitrogen level in the apparatus.

Accordingly, one object of the invention is to improve the above-mentioned apparatus so that the use of a recirculation system involving the necessity of cleaning and risks of operational stoppages may be prevented.

Another objet is to provide a vibrating freezing apparatus having the possibility to easily and precisely adjust the level of liquid nitrogen.

These objects are achieved by a freezing apparatus of the type where a product is supplied to an open vessel (1) in which liquefied nitrogen is conveyed together with the product and flows from one end of the vessel to the other, open end of the vessel, and where at least one vibrator means (20) can vibrate the vessel for conveying the product, characterized in that the bottom of the vessel is formed as a liquefied nitrogen reservoir, said vessel being placed on a frame having height-adjustable legs (7, 8).

The frame with height-adjustable legs provides the possibility of adjusting the amount of liquefied nitrogen in the reservoir, since the legs can merely be adjusted so that the vessel will be inclined.

When a reservoir is thus formed on the bottom of the open vessel, a liquefied nitrogen bath may be provided, where liquefied nitrogen is just to be fed in step with the consumption of the nitrogen.

Expediently, the reservoir is formed such that the bottom of the vessel is elevated at the open end, e.g. as a ramp, cf. claim 2. This provides a constructional detail allowing the amount of liquefied nitrogen to be adjusted in a simple manner.

Further, it is advantageous in an embodiment that a level detector is provided at the end wall of the vessel,

since the amount of liquefied nitrogen in the vessel may be kept constantly under control in that the level detector signals a valve to supply/cut off liquefied nitrogen.

It is a further advantage, as stated in claim 4, that a sensor communicates with the level detector, said sensor being adapted to prevent supply of liquefied nitrogen if the gas separator is not in position. This detail is extremely advantageous for safety reasons, since it prevents supply of liquefied nitrogen in uncontrolled amounts.

Mounting of the level detector on a separator for separating gas/liquid provides the advantage that turbulence in the actual vessel may be avoided, which results in an accurate level regulation.

Finally, it is an advantage in connection with cleaning that the vessel may be tilted by means of at least one air cylinder.

As mentioned, the invention also concerns the use of the freezing apparatus. The use of this apparatus is defined more fully in claim 8.

The invention will now be explained more fully in connection with a preferred embodiment and with reference to the drawing, in which Fig. 1 is a schematic partially front view of the freezing apparatus of the invention, Fig. 2 is a schematic lateral view of the freezing apparatus, Fig. 3 is a schematic view of the freezing apparatus in a position in which it is made ready for cleaning, and Fig. 4 is a schematic view of a gas separator having a level detector for insertion into the vessel.

As shown by the drawing, the freezing apparatus, in a preferred embodiment of the invention, comprises an open vessel 1, which has a bottom 4, two side walls 2, 3 and an end wall 6. An opening 5 is provided in the vessel 1 opposite the end wall. As will be seen in fig. 2, the bottom is raised at the open end of the vessel with respect to the rest of the bottom, here shown as a ramp

22, which may typically have a height of 5 to 30 mm. As moreover shown in fig. 2, the vessel is suspended from springs 9, so that the vessel may be caused to vibrate by means of at least one vibrator 20. The springs 9 rest on a frame which has four height-adjustable legs 7, 8, which are interconnected by means of two transverse profiles 25. The actual vessel is double-walled, an insulating layer of polyurethane foam being provided between the walls. Fig. 2 moreover shows a suction unit 11 which is intended to suck out the cold gaseous nitrogen which evaporates from the surface of the liquefied nitrogen. Owing to its low temperature the gaseous nitrogen has a higher specific gravity than the atmospheric air, so that the gas settles immediately above the layer of the liquefied nitrogen, and as it reaches beyond the side face at the open end of the vessel, the suction unit 11 can easily suck the gas away to a suction system (not shown). It will be seen, cf. also fig. 4, that a gas/liquid separator is arranged at the closed end of the vessel, said separator operating in the manner that liquefied nitrogen is supplied via a pipe 13 down into the separator 16, whereby gas escapes from an upper edge 17 of the separator, while liquefied nitrogen is discharged through an opening 18 at the bottom of the separator.

Further, cf. fig. 2, the pipe 13 is connected with an insulated inlet pipe 14 for liquefied nitrogen. A level detector (not shown) is arranged on the separator in a pipe 19 for detecting the height of liquefied nitrogen in the vessel 1, cf. fig. 4. The sensor is of a known ultrasound type and will therefore not be described in greater detail here. A spacer 15 is provided in connection with the sensor and the gas/liquid separator, said spacer having an electronic unit (not shown) with a further sensor to detect whether the gas separator is in position. If it turns out that the gas separator is not in position, the supply of liquefied nitrogen cannot be

established. Further, the vessel cannot be raised for cleaning.

Fig. 3 shows the freezing apparatus of the invention in a position in which it is made ready for cleaning. More particularly, the ultrasound sensor and the gas separator 15 are removed from the vessel. At least one air cylinder 10, which is provided at one spring 9, has been caused to raise the vessel in an inclined direction. Hereby, the vessel can easily be cleaned by flushing, since cleaning materials can now flow beyond the edge.

The operation of the freezing apparatus will be explained more fully below.

A product, which may e.g. be granulated and tacky having a high water content, is supplied together with liquefied nitrogen in the vessel 1 at the closed end of the vessel. The product now freezes rapidly, and with simultaneous vibration of the vessel by means of the vibrator 20, the rate at which the product moves through the vessel may be regulated. When the product has reached the open end, it is frozen and can now be discharged beyond the edge, where it may be supplied to e.g. a conveyor belt for further processing. The shown ultrasound sensor 21, fig. 2, constantly checks that the proper amount of liquefied nitrogen is present in the vessel. Further, the apparatus has a typical capacity of 100-200 kg per hour if a product is to be frozen-through.

CLAIMS

1. A freezing apparatus of the type where a product is supplied to an open vessel (1) in which liquefied nitrogen is conveyed together with the product and flows from one end of the vessel to the other, open end of the vessel, and where at least one vibrator means (20) can vibrate the vessel for conveying the product, characterized in that the bottom of the vessel is formed as a liquefied nitrogen reservoir, said vessel being placed on a frame having height-adjustable legs (7, 8).

2. An apparatus according to claim 1, characterized in that the reservoir is provided in that the bottom of the vessel is raised at the open end, e.g. as a ramp (22).

3. An apparatus according to any of claims 1 or 2, characterized in that a level detector is arranged at an end wall (6) of the vessel.

4. An apparatus according to claim 3, characterized in that a sensor communicates with the level detector, said sensor being adapted to prevent supply of liquefied nitrogen if the gas separator is not in position.

5. An apparatus according to claim 3 or 4, characterized in that the level detector is mounted on a separator (16) for separating gas/fluid (17, 18).

6. An apparatus according to any of the preceding claims, characterized in that a suction device (11) is provided immediately below the vessel close to the opening thereof.

7. An apparatus according to any of the preceding claims, characterized in that the vessel may be tilted by means of an air cylinder (10).

8. Use of an apparatus according to claims 1-7 for complete or partial freezing of shrimps, clams, minced meat and the like.

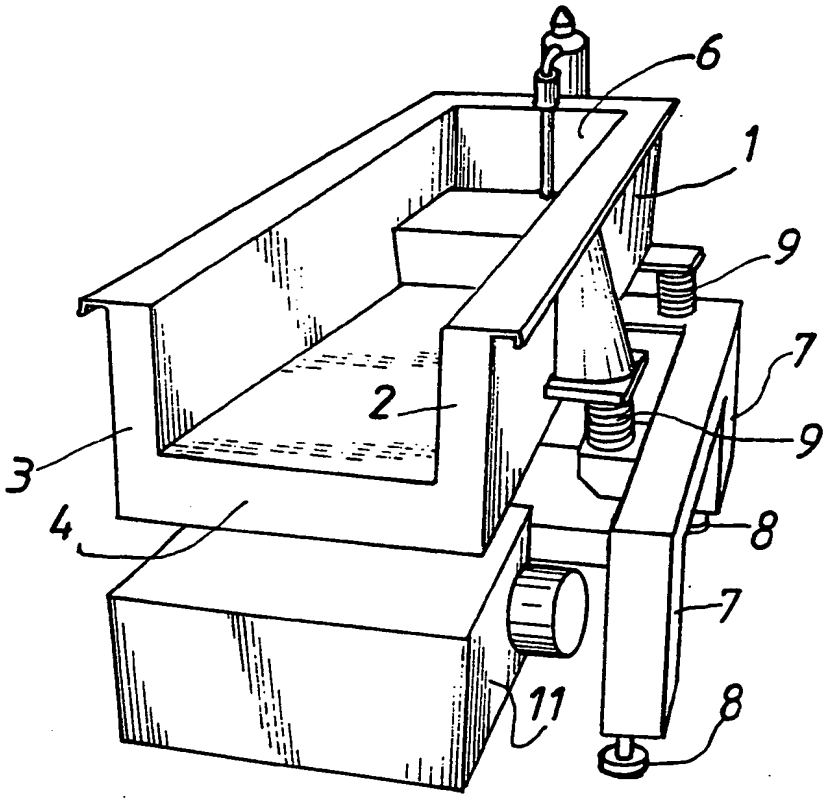


FIG.1

2/2

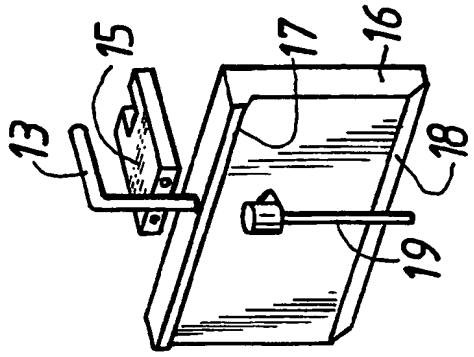


FIG.4

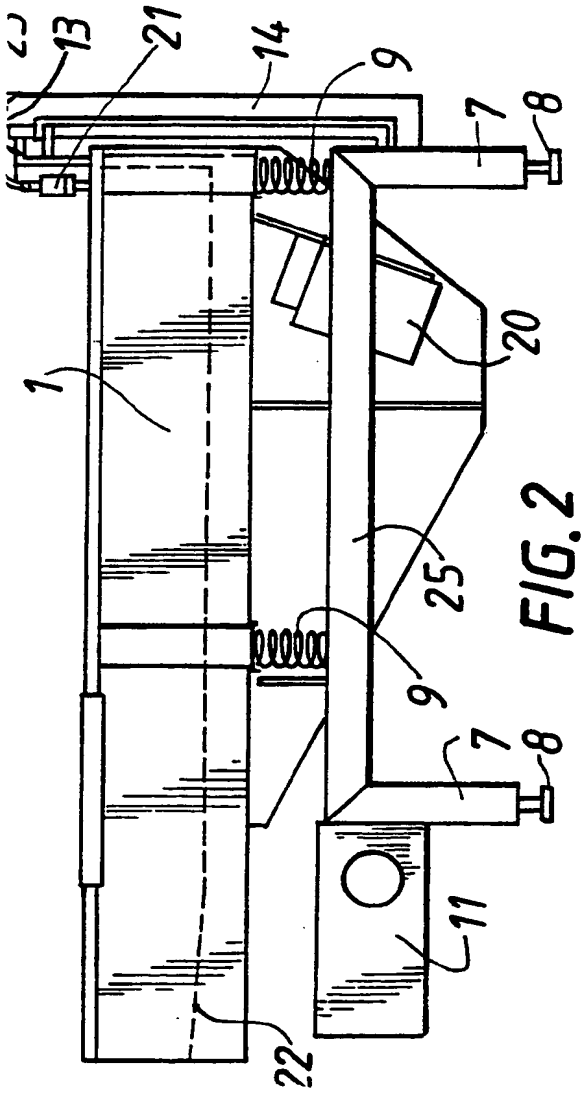


FIG.2

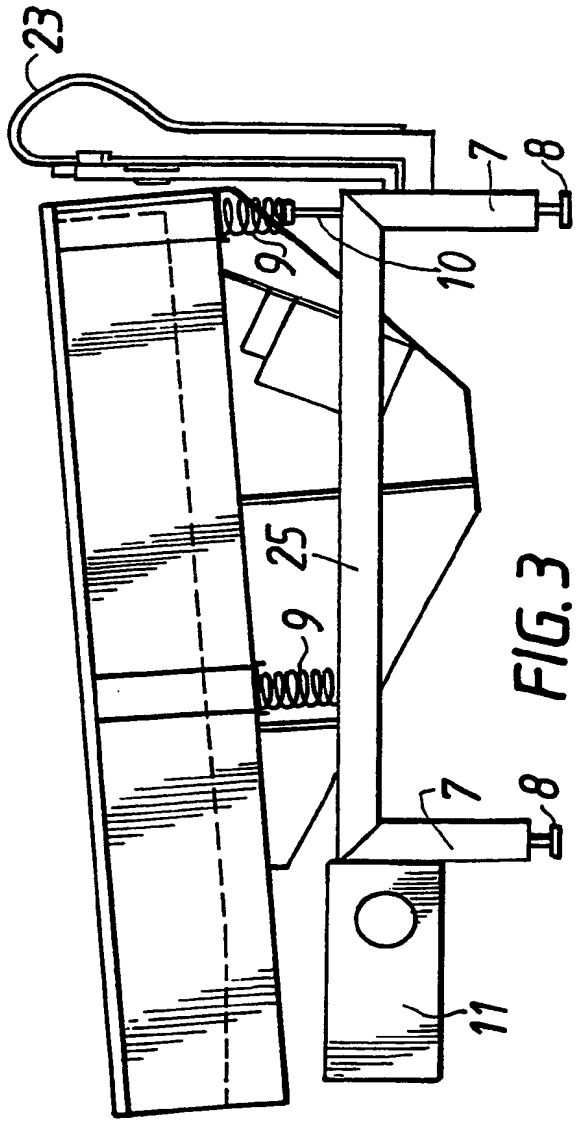


FIG.3

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/EP 95/02426

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F25D25/04 F25D3/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 505 222 (L'AIR LIQUIDE SA) 23 September 1992 see column 4, line 10 - line 25 see column 5, line 7 - line 10	1
A	see column 2, line 15 - line 21	8
Y	EP,A,0 252 584 (THE BOC GROUP) 13 January 1988 see column 9, line 5 - line 52	1
A	FR,A,2 212 521 (OSAKA GAS KABUSHIKI KAISHA) 26 July 1974 see page 6, line 7 - line 20 see page 6, line 28 - line 37	1-3
A	US,A,4 171 625 (MORGAN) 23 October 1979 see column 5, line 33 - line 41 see column 12, line 45 - line 64	1,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search
27 September 1995

Date of mailing of the international search report
04. 10. 95

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+ 31-70) 340-3016

Authorized officer
Hauglustaine, H

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int onal Application No
PCT/EP 95/02426

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-505222	23-09-92	FR-A-	2674320	25-09-92
		AU-B-	658178	06-04-95
		AU-A-	1544192	21-10-92
		WO-A-	9216803	01-10-92
		NZ-A-	241978	27-09-94
		US-A-	5299426	05-04-94
EP-A-252584	13-01-88	AU-A-	7271987	19-11-87
		JP-A-	62296867	24-12-87
		US-A-	4782668	08-11-88
FR-A-2212521	26-07-74	JP-A-	49088143	23-08-74
		BE-A-	809132	16-04-74
		DE-A-	2364749	18-07-74
		US-A-	3889488	17-06-75
US-A-4171625	23-10-79	CA-A-	1086519	30-09-80